

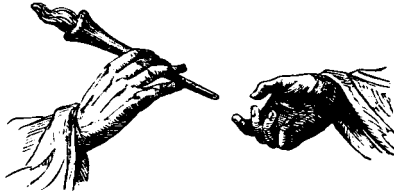
THE
PHILOSOPHY
OF THE
INDUCTIVE SCIENCES,

FOUNDED UPON THEIR HISTORY.

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A NEW EDITION,
WITH CORRECTIONS AND ADDITIONS, AND
AN APPENDIX, CONTAINING
PHILOSOPHICAL ESSAYS PREVIOUSLY PUBLISHED.

IN TWO VOLUMES.



Λαμπάδια ἔχοντες διαδώσουσιν ἀλλήλοις.

VOLUME THE FIRST.

LONDON:
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M.DCCC.XLVII.

TO THE
REV. ADAM SEDGWICK, M.A.,
SENIOR FELLOW OF TRINITY COLLEGE,
WOODWARDIAN PROFESSOR OF GEOLOGY IN THE UNIVERSITY OF
CAMBRIDGE, AND PREBENDARY OF NORWICH.

MY DEAR SEDGWICK,

WHEN I showed you the last sheet of my *History of the Inductive Sciences* in its transit through the press, you told me that I ought to add a paragraph or two at the end, by way of Moral to the story; and I replied that the Moral would be as long as the story itself. The present work, the *Moral* which you then desired, I have, with some effort, reduced within a somewhat smaller compass than I then spoke of; and I cannot dedicate it to any one with so much pleasure as to you.

It has always been my wish that, as far and as long as men might know anything of me by my writings, they should hear of me along with the friends with whom I have lived, whom I have loved, and by whose conversation I have been animated to hope that I too might add something to the literature of our country. There is no one whose name has, on such grounds, a better claim than yours to stand in the front of a work, which has been the subject of my labours for no small portion of our long period of friendship. But there is another reason which gives a peculiar propriety to this dedication of my Philosophy to you. I have little doubt that if your life had not been absorbed in struggling with many of the most difficult problems of a difficult science, you would have been my fellow-labourer or master in the work which I have here undertaken. The same spirit which dictated your vigorous protest against some of the errors which I also attempt to expose, would have led you, if your thoughts had been

more free, to take a leading share in that Reform of Philosophy, which all who are alive to such errors, must see to be now indispensable. To you I may most justly inscribe a work which contains a criticism of the fallacies of the ultra-Lockian school.

I will mention one other reason which enters into the satisfaction with which I place your name at the head of my Philosophy. By doing so, I may consider myself as dedicating it to the College to which we both belong, to which we both owe so much of all that we are, and in which we have lived together so long and so happily; and *that*, be it remembered, the College of Bacon and of Newton. That College, I know, holds a strong place in your affections, as in mine; and among many reasons, not least on this account;—we believe that sound and enduring philosophy ever finds there a congenial soil and a fostering shelter. If the doctrines which the present work contains be really true and valuable, my unhesitating trust is, that they will spread gradually from these precincts to every part of the land.

That this office of being the fosterer and diffuser of truth may ever belong to our common Nursing Mother, and that you, my dear Sedgwick, may long witness and contribute to these beneficial influences, is the hearty wish of

Yours affectionately,

W. WHEWELL.

Trinity College, May 1, 1840.

P R E F A C E
TO THE
S E C O N D E D I T I O N .

IN the Preface to the first edition of this work, it was stated that the work was intended as an application of the plan of Bacon's *Novum Organon* to the present condition of Physical Science. Such an undertaking, it was there said, plainly belongs to the present generation. Bacon only divined how sciences might be constructed; we can trace, in their history, how their construction has taken place. However sagacious were his conjectures, it may be expected that they will be further illustrated by facts which we know to have really occurred. However large were his anticipations, the actual progress of science since his time may aid in giving comprehensiveness to our views. And with respect to the methods by which science is to be promoted,—the structure and operation of the *Organ* by which truth is to be collected from nature,—we know that, though Bacon's general maxims still guide and animate philosophical enquirers yet that his views, in their detail, have all turned out inapplicable: the technical parts of his method failed in his hands, and are forgotten among the cultivators of science. It cannot be an unfit task, at the present day, to endeavour to extract from the actual past progress of science, the elements of a more effectual and sub-

stantial Method of Discovery. The advances, which have, during the last three centuries, been made in the physical sciences;—in Astronomy, in Physics, in Chemistry, in Natural History, in Physiology;—these are allowed by all to be real, to be great, to be striking: may it not be, then, that these steps of progress have in them something alike?—that in each advancing movement there is some common process, some common principle?—that the organ by which discoveries have been made has had something uniform in its structure and working? If this be so, and if we can, by attending to the past history of science, discover something of this common element and common process in all discoveries, we shall have a *Philosophy of Science*, such as our times may naturally hope for:—we shall have the *New Organ* of Bacon, *renovated* according to our advanced intellectual position and office.

It was with the view to such a continuation and extension of Bacon's design, that I undertook that survey of the *History of Science* which I have given in another work; and that analysis of the advance of each science which the present work contains. Of the doctrines promulgated by Bacon, none has more completely remained with us, as a stable and valuable truth, than his declaration that true knowledge is to be obtained from Facts by *Induction*: and in order to denote that I start at once from the point to which Bacon thus led us, I have, both in the *History* and in the *Philosophy*, termed the sciences with which I have to do, *the Inductive Sciences*. By treating of the Physical Sciences only, while I speak of the Inductive Sciences in the description of

my design, I do not, (as I have already elsewhere said*) intend to deny the character of Inductive Sciences to many other branches of knowledge, as for instance, Ethnology, Glossology, Political Economy, and Psychology. But I think it will be allowed that by taking, as I have done, the Physical Sciences alone, in which the truths established are universally assented to, and regarded with comparative calmness, we are better able to discuss the formal conditions and general processes of scientific discovery, than we could do if we entangled ourselves among subjects where the interest is keener and the truth more controverted. Perhaps a more exact description of the present work would be, *The Philosophy of the Inductive Sciences, founded upon the History of the principal Physical Sciences.*

I am well aware how much additional interest and attractiveness are given to speculations concerning the progress of human knowledge, when we include in them, as examples of such knowledge, views on subjects of politics, morals, beauty in art and literature, and the like. Prominent instances of the effect of this mode of treating such subjects have recently appeared. But I still think that the real value and import of Inductive Philosophy, even in its application to such subjects, are best brought into view by making the progress of political, and moral and *callesthetical*† truth a subject of consideration apart from physical science.

It can hardly happen that a work which treats of Methods of Scientific Discovery shall not seem to fail in

* *Hist. Ind. Sci.* Second Edition. Note to the Introduction.

† See Vol. II. On the Language of Science, Aphorism, xvii.

the positive results which it offers. For an Art of Discovery is not possible. At each step of the progress of science, are needed invention, sagacity, genius;—elements which no Art can give. We may hope in vain, as Bacon hoped, for an organ which shall enable all men to construct scientific truths, as a pair of compasses enables all men to construct exact circles*. The practical results of the Philosophy of Science must, we are persuaded, be rather classification and analysis than precept and method. I think however that the methods of discovery which I have to recommend, though gathered from a wider survey of scientific history, as to subject and as to time, than, (so far as I am aware,) has been elsewhere attempted, are quite as definite and practical as any others which have been proposed; with the great additional advantage of being the methods by which all great discoveries in physical science really have been made. This may be said, for instance, of *the Method of Gradation*, and *the Method of Natural Classification*, spoken of Book XIII. Chap. VIII.; and in a narrower sense, of *the Method of Curves*, *the Method of Means*, *the Method of Least Squares*, and *the Method of Residues*, spoken of in Chap. VII. of the same Book. Also the Remarks on the *Use of Hypotheses* and on the *Tests of Hypotheses* (Book XI. Chap. v.) point out features which mark the usual course of discovery.

But undoubtedly one of the principal lessons which results from the views here given is that different sciences may be expected to advance by different modes of procedure, according to their present condition; and

* *Nov. Org.* Lib. 1. Aph. 61.

that, in many of these sciences, an *Induction* performed by any of the methods just referred to, is not the step which we may expect to see next made. Several of the sciences may not be in a condition which fits them for such a *Colligation of Facts*, (to use the phraseology to which the succeeding analysis has led me. See B. XI. C. 1). The Facts may, at the present time, require to be more fully observed, or the Idea by which they are to be colligated may require to be more fully unfolded.

But in this point also, our speculations are far from being barren of practical results. The Philosophy of each Science, as given in the present work, affords us means of discerning whether that which is needed for the further progress of the Science has its place in the Observations, or in the Ideas, or in the union of the two. If Observations be wanted, the *Methods of Observation* given in Book XIII. Chap. II. may be referred to; if those who are to make the next discoveries need, for that purpose, a developement of their Ideas, the modes in which such a developement has usually taken place are treated of in Chapters III. and IV. of that Book.

Perhaps one of the most prominent points of this work is the attempt to show the place which discussions concerning Ideas have had in the progress of science. The metaphysical aspect of each of the physical sciences is very far from being, as some have tried to teach, an aspect which it passes through previously to the most decided progress of the science. On the contrary, the metaphysical is a necessary part of the inductive movement. This, which is evidently so by the nature of the

case, is proved by a copious collection of historical evidences in the first ten Books of the present work. Those Books contain an account of the principal philosophical controversies which have taken place in all the physical sciences, from Mathematics to Physiology; and these controversies, which must be called *metaphysical* if anything be so called, have been conducted by the greatest discoverers in each science, and have been an essential part of the discoveries made. Physical discoverers have differed from barren speculators, not by having *no* metaphysics in their heads, but by having *good* metaphysics while their adversaries had bad; and by binding their metaphysics to their physics, instead of keeping the two asunder. I trust that the ten Books of which I have spoken are of some value, even as a series of analyses of a number of remarkable controversies; but I cannot conceive how any one, after reading these Books, can fail to see that there is in progressive science a metaphysical as well as a physical element;—ideas, as well as facts,—thoughts, as well as things:—in short, that the *Fundamental Antithesis*, for which I contend, is there most abundantly and strikingly exemplified.

On the subject of this doctrine of a Fundamental Analysis, which our knowledge always involves, I will venture here to add a remark, which looks beyond the domain of the physical sciences. This doctrine is suited to throw light upon Moral and Political Philosophy, no less than upon Physical. In Morality, in Legislation, in National Polity, we have still to do with the opposition and combination of two Elements;—of Facts and Ideas; of History, and an Ideal Standard of Action; of actual

character and position, and of the aims which are placed above the Actual. Each of these is in conflict with the other; each modifies and moulds the other. We can never escape the control of the first; we must ever cease to strive to extend the sway of the second. In these cases, indeed, the Ideal Element assumes a new form. It includes the Idea of Duty. The opposition, the action and re-action, the harmony at which we must ever aim, and can never reach, are between what *is* and what *ought* to be;—between the past or present Fact, and the Supreme Idea. The Idea can never be independent of the Fact, but the Fact must ever be drawn towards the Idea. The History of Human Societies, and of each Individual, is by the moral philosopher, regarded in reference to this Antithesis; and thus both Public and Private Morality becomes an actual progress towards an Ideal Form; or ceases to be a moral reality.

I have made very slight alterations in the first edition, except that the First Book is remodelled with a view of bringing out more clearly the basis of the work;—this doctrine of the Fundamental Antithesis of Philosophy. This doctrine, and its relation to the rest of the work, have become more clear in the years which have elapsed since the first edition.

A separate Essay, in which this doctrine was explained, and a few other Essays previously published in various forms, and containing discussions of special points belonging to the scheme of philosophy here delivered, have attracted some notice, both in this and in other countries. I have therefore added them as an Appendix to the present edition.

• I have added a few Notes, in answer to arguments brought against particular parts of this work. I have written these in what I have elsewhere called an *impersonal* manner; wishing to avoid controversy, so far as justice to philosophical Truth will allow me to do so.

I have not given any detailed reply to the criticisms of this work which occur in Mr. Mill's *System of Logic*. The consideration of these criticisms would be interesting to me, and I think would still further establish the doctrines which I have here delivered. But such a discussion would involve me in a critique of Mr. Mill's work; which if I were to offer to the world, I should think it more suitable to publish separately.

More than one of my critics has expressed an opinion that when I published this work, I had not given due attention to the *Cours de Philosophie Positive* of M. Comte. I had, and have, an opinion of the value of M. Comte's speculations very different from that entertained by my monitors. I had in the former edition discussed, and, as I conceive, confuted, some of M. Comte's leading doctrines*. In order further to show that I had not lightly passed over those portions of M. Comte's work which had then appeared, I now publish† an additional portion of a critique of the work which, though I had written, I excluded from the former edition. This is printed exactly as it existed in manuscript at the period of that publication. To return to the subject and to take it up in all its extent, would be an undertaking out of the range of a new edition of my published work.

* B. XI. c. vii. B. XIII. c. iv.

† B. XII. c. xvi.

Bacon delivered his philosophy in Aphorisms;—a series of Sentences which profess to exhibit rather the results of thought than the process of thinking. A mere Aphoristic Philosophy unsupported by reasoning, is not suited to the present time. No writer upon such subjects can expect to be either understood or assented to, beyond the limits of a narrow school, who is not prepared with good arguments as well as magisterial decisions upon the controverted points of philosophy. But it may be satisfactory to some readers to see the Philosophy, to which in the present work we are led, presented in the Aphoristic form. I have therefore placed a Series of Aphorisms at the end of the work. In the former edition these, by being placed at the beginning of the work, might mislead the reader; seeming to some, perhaps, to be put forwards as the grounds, not as the results, of our philosophy. I have also prefixed an analysis of the work, in the form of a Table of Contents to each volume.

In that part of the second volume which treats of the Language of Science, I have made a few alterations and additions, tending to bring my recommendations into harmony with the present use of the best scientific works.

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THE
PHILOSOPHY
OF THE
INDUCTIVE SCIENCES.

PART I.
OF IDEAS.

VOL. I. W. P.

Quæ adhuc inventa sunt in Scientiis, ea hujusmodi sunt ut Notionibus Vulgaribus fere subjaceant: ut vero ad interiora et remotiora Naturæ penetretur, necesse est ut tam NOTIONES quam AXIOMATA magis certâ et munitâ viâ a particularibus abstrahantur; atque omnino melior et certior intellectûs adoperatio in usum veniat.

BACON, *Nov. Org.*, Lib. I. Aphor. xviii.